copy enclosed, means a machine element for preventing relative rotation. The use of the term "key" to designate a "hook" is therefore incorrect. A "hook" is defined as a "curved or bent device for catching, holding or pulling" in Webster's Collegiate Dictionary, copy enclosed. Therefore, the term "key" was incorrectly used to designate a "hook" on page 3, lines 16, 37, and 38. Applicant regrets the error of misapplication of the term "key" and requests that the correction be entered.

Applicant respectfully submits that the correction of the use of the term "key" and that the term be replaced with the term "hook" does not constitute the submission of new matter since the term "hook" was consistently used throughout the specification in its correct meaning, on page 1, line 16, page 2, line 21, page 3, lines 36, 37, page 4, lines 3, 27, 28, 29, 41, page 5, lines 5, 17, 19, 20, 40, page 6, lines 14, 15, 27, 33, 36, page 7, lines 1, 18, 19, and in original Claim 3.

The specification has been amended on page 5, line 5 is to correct a typographical error by deleting the single letter "b" and inserting therefore the term "by" to correct the terminology.

The specification has been amended on page 5, line 38 to delete the term "books" and inserting therefore the term "hooks" to correct a typographical error.

The specification has been amended on page 7, line 4 to delete the term "it" after the word "Rather," to eliminate a typographical error.

Applicant regrets the above typographical errors on pages 2, 5 and 7, and requests the above corrections be entered and that the above corrections do not constitute new matter.

Claim 1 has been amended in line 1 to insert the phrase "<u>for milling machinery comprising at least a three-axis computer numerical control milling machine</u>" to correctly designate the milling machine used. Basis appears in the specification on page 5, lines 23-26.

Claim 1 has been amended in line 1 to insert the phrase "<u>to machine precise concave and convex surfaces within a metal block</u>" to correctly designate and claim the invention being claimed. Basis appears in the specification on page 2, lines 31-33.

Claim 1 has been amended in line 1 to insert the phrase "<u>said method comprising, in combination,</u>" to refer back to said method of line 1, and to insert the words "<u>in combination</u>" to reference the cooperation among the elements of the invented method to function as a unity. Applicant respectfully submits the insertion is not new matter and merely makes explicit a disclosure that was implicit in the application as filed (Tektromix, Inc. v. United States, 165 U.S.P.Q. 392).

Claim 1 has been amended in lines 2-4, to read "using a machine having a <u>spinning form</u> cutter <u>and a rotary table</u> (see page 5, lines 7-11), the surfaces of the work piece being defined by a plurality of programmed instructions <u>for said computer numerical control milling machine</u> obtained by trigonometric analysis of required curvatures of the surfaces <u>and movements of said spinning form cutter and said rotary table, said movement of said spinning form cutter being in a convex path and said movement of said rotary table being to rotate simultaneously from a plus rotation angle to a minus rotation angle and, alternatively, from a minus rotation angle to a plus rotation angle</u> (see page 2, lines 39-44, page 3, lines 1-18), <u>said programmed instructions determined by said trigonometric analysis of a diagram</u> (see page 2, line 19) of <u>required concave and convex surfaces of resulting root section of a turbine blade</u> (see page 2, lines 21-27) <u>and movements of said spinning form cutter and rotary table</u> (see page 2, lines 39-

44, page 3, lines 1-18), said root section having at least a first hook as a first holding hook" (see page 3, lines 36-38).

Claim 2 has been amended to read "The method of Claim 1 wherein said trigonometric analysis of the required curvatures of the surfaces comprises an analysis of a diagram (see page 2, line 19) of a graphical construction of the required curvatures of the surfaces and movements of said spinning cutter and said rotary table (see page 2, lines 39-44, page 3, lines 1-18) relative to the application of said spinning form cutter [the cutting tool] (see page 2, lines 39-44, page 3, lines 1-18) to the required curvatures of said [the] root section of said [the] turbine blade, said graphical construction consisting essentially of a trigonometric analysis, said root section comprising at least one holding hook [holding key] (see page 3, lines 37-38)."

Claim 3 has been amended to read "The method of Claim 1 wherein said trigonometric analysis of the required curvatures of the surfaces and movements of said spinning cutter and said rotary table (see page 2, lines 39-44, page 3, lines 1-18) determines the path of said spinning form cutter (see page 5, lines 7-11) as a curved convex radius of E plus R wherein E is the distance from [form] center of rotary table to first holding hook (see page 3, line 38) and R is the radius on the first holding hook [holding key] (see page 3, line 37).

Claim 4 has been amended in line 2 to insert the terms "spinning form" before the term "cutter" to properly refer back to the "spinning form cutter" in amended Claim 1.

Claim 4 has been amended in line 2 to insert after the term "surfaces" the phrase "and movements of said spinning cutter and said rotary table" to properly refer back to the terminology of amended Claim 1.

Claim 4 has been amended in line 7 to insert after the term "right," the following "E being the distance from center of rotary table to first holding hook, and R is the radius on the first holding hook." Basis appears in the specification on page 3, lines 37-38.

Separate pages of the abstract, the amended specification and the amended claims are herewith submitted.

The abstract of the disclosure is objected to by the Examiner because it is not on a separate page. A separate page is herewith submitted to overcome the objection.

Claims 1 – 3 are objected to because of the following informalities:

Referring to Claims 1 and 2, the claims should end with a period instead of a semicolon.

Referring to Claim 3, the word – form – should be replaced with "from."

Appropriate correction is herewith submitted.

The Examiner has rejected Claims 2, 3 and 4 under 35 U.S.C. 112.

Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to point out and distinctly claim the subject matter which applicant regards as the invention. Claim 2 recites the limitations "the root section" and "the turbine blade." There is insufficient antecedent basis for this limitation in the claim. Applicant submits that Claim 1 has been amended herewith to provide proper antecedent basis for the above limitation.

Claim 3 is rejected under 35 U.S.C. second paragraph, as being indefinite in that the claim recites the limitation "to first hook" and "the first hook holding key" and that there is insufficient basis for this limitation in the claim. Applicant submits that Claim 1 has been amended herewith to provide proper antecedent basis for the above limitation.

Claim 4 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter the applicant regards as the invention in that the variables "E" and "R" are disclosed but the claim does not define said variables. Applicant submits that Claim 4 has been amended to define the said variables.

The Examiner has rejected Claim 1 under 35 U.S.C. 102(b) as being anticipated by Rathi et al, U.S. Patent 5,285,572, in that Rathi discloses a method of determining machining instructions during machining of a workpiece using a machine having a cutter whereby a "milling machine" inherently contains a cutter, and whereby the surfaces of the workpiece are defined by a plurality of programmed instructions obtained by trigonometric analysis at required curvatures of the surfaces.

Applicant respectfully traverses and requests reconsideration.

Applicant respectfully submits that Claim 1, as amended, is not anticipated under 35 U.S.C. 102(b). Applicant respectfully submits that to constitute anticipations all the material claimed elements must be found within the four corners of a single prior art reference (In re Outrup, 189 U.S.P.Q. 345). Applicant respectfully submits that Rathi '572 does not teach, suggest or anticipate within the four corners of the reference all the material claimed elements of the instant invention.

Applicant respectfully submits that independent Claim 1, as amended, claims a method of determining machining instructions for a milling machine comprising at least a three-axis computer numerical control milling machine during machining of a work piece to machine precise concave and convex surfaces within (emphasis added) a metal block, the said method comprising, in combination, using a machine having a spinning form cutter and a rotary table, the said surfaces being defined by a plurality of programmed instructions for the said milling machine obtained by trigonometric analysis of required curvatures of the surfaces and movements of the spinning form cutter and rotary table, the movements of the form cutter being in a convex path and movement of the rotary table being to rotate simultaneously from a plus rotation angle to a minus rotation angle, and, alternatively from a minus rotation angle to a plus rotation angle, said programmed instructions determined by said trigonometric analysis of a diagram of required concave and convex surfaces of resulting root section of a turbine blade and movements of said spinning form cutter and rotary table, asid root section comprising at least one holding hook.

Applicant submits that all of the features of the instant invention, as claimed in Claim 1, are not recited in the reference of Rathi '572. Applicant therefore submits that amended Claim 1 and dependent Claims 2, 3, and 4, as dependent upon amended independent Claim 1, are not anticipated by the reference of Rathi '572.

In further explanation that Claims 1, 2, 3, and 4 are not anticipated by Rathi '572, Applicant directs the Examiner's attention to Rathi '572, Column 1, lines 59-64, which state "An object of the present invention is to provide a method and system for generating a machining contour profile or blueprint of an actual outer surface of the vane (emphasis added) which may be used to machine the outer surface of the vane (emphasis added). Rathi '572 teaches, Column 2, lines 5-9 "a process for repairing a vane ... by utilizing the actual surface (emphasis

added) of the vane to generate a machining contour profile or blueprint from which the outer surface of the vane (emphasis added) can be machined by a computer numerical machine." FIG. 1 of Rathi '572 is a perspective sectional view of a typical vane to be repaired and FIG. 8 is a view of a profile of the outer surface of the vane showing original contour points along a common plane (of the outer surface) and a generated machining contour (of the outer surface). Rathi '572 teaches, Column 2, lines 14-30, "(b) sensing a series of original digitized contour data points; ... ; (c) calculating an original digitized contour profile corresponding to said series of original digitized contour data points; ... ; (e) generating a revised digitized contour profile using revised data points which are calculated ... (g) generating a machining profile from said revised digitized contour points; and (h) machining said part ..."

Rathi '572 teaches, Column 3, lines 61-66, the method to generate the revised contour file uses algorithms for each cross-section of the outer surface (to be machined), an algorithm being a procedure for solving mathematical problems, Rathi '572 teaching, Column 6, lines 11-44, use of the Euler method for solving algebraic equations, and other methods for solving linear algebraic equations to create a revised contour of data points.

Applicant accordingly respectfully submits that Rathi '572 discloses a method for determining machining instructions for machining the outer surface of a part such as a turbine vane by using a sensing device to locate a series of original digitized contour data points on the outer surface of the vane, calculating a revised contour profile using the data points using an algebraic procedure to solve the algebraic equations generated therefrom to generate a machining profile to machine the surface of the turbine vane.

The Examiner's position is that Rathi '572 obtains a plurality of programmed instructions obtained by trigonometric analysis of required curvatures of the surfaces (Column 3, lines 35-54). Applicant respectfully brings to the Examiner's attention that Rathi '572 (Column 3, lines 35-54) teaches use of a sensing device, Model 500 of Lazer Design, Inc., for sensing a series of original digitized contour data points along the outer surface of the subject vane, generating X, Y, and Z values for each point along the a path on the outer surface of the vane. These data are used to calculate the machining instructions file using an algorithm, Column 3, lines 60-65, by the method of Euler to solve algebraic equations, or of Benson and Evans, Column 6, lines 10-55. The revised contour profile is thereupon used to machine the outer surface of its vane, by converting the contour profile to a computer program by a computer processing means such as an IBM Model 4341, Column 4, lines 3-19.

Applicant respectfully submits that Rathi '572 does not determine machining instructions by trigonometric analysis of required curvatures of the surfaces but uses a sensing device to determine the location of position data points which are used in linear algebraic equations to define a contour profile of a surface which is then converted to a computer program to program the milling machine to mill the outer surface of a vane ascending to the contour profile of the outer surface of the vane.

Applicant therefore respectfully submits that Rathi '572 does not anticipate, teach, disclose, suggest or otherwise indicate in any manner the method of the instant invention to machine interior surfaces of a metal block, not the exterior surfaces, wherein the surfaces are concave and convex, wherein the milling machine requires a spinning form cutter traveling on a convex path and a rotary table rotating simultaneously from a plus rotation angle to a minus rotation angle, and, alternatively, from a minus rotation angle to a plus rotation angle, wherein the programmed instructions are obtained by trigonometric analysis of a diagram of the required concave and convex surfaces of the resulting interior surfaces of the metal block and the movements of the spinning form cutter and of the rotary table.

Applicant therefore respectfully submits that the method of the instant invention is not anticipated by Rathi '572 in view of the different analysis procedures of obtaining data and different requirements of the analysis procedures. Applicant respectfully submits that it is unexpected that a unique method of a graphical construction of required interior concave and convex surfaces within a metal block and the required convex path of a spinning form cutter and simultaneous movements of a rotary table holding the metal block from a plus rotation angle to a minus rotation angle, and, alternatively, from a minus rotation angle to a plus rotation angle, can provide the unique means for trigonometric analysis of the required concave and convex surfaces within the metal block and the path of the form cutter in conjunction with the simultaneous movement of the rotary table to program a milling machine to mill precise concave and convex surfaces within a metal block of the root section of a turbine blade comprising at least one holding hook wherein the prior art, Rathi '572, teaches only a method for machining the outer surface of an object using mechanical devices to determine measurements of an outer surface of an object, which measurements are used to calculate a machining instruction file using an algorithm to solve the resulting algebraic equations by the method of Euler, the machining instruction file being converted to a computer program using a computer processing means such as an IBM Model 4341.

The Examiner has rejected Claim 2 under 35 U.S.C. 103(a) as being unpatentable over Rathi '572 as indicated in the rejection of Claim 1 under 35 U.S.C. 102(b) and further in view of Shiohata et al, U.S. Patent 4,245,950.

It is the Examiner's position that Rathi '572 discloses the method of machining instructions and that Rathi '572 also discloses that trigonometric analysis of the required curvatures of the surfaces comprises a graphical construction of the required surfaces relative to the application of the cutting tool to the required curvatures of the item being machined and that the graphical construction consists essentially of a trigonometric analysis (Column 3, lines 35-54 and Column 8, lines 3-27).

Applicant respectfully submits that the specification and Claims 2 and 3 have herewith been amended to delete the term "key" to correct the misuse of its term as being inapplicable to the description of the instant invention. Applicant regrets the mistaken misuse of the word "key" to describe the "hook" formation within the root section of the turbine blade and requests that correction of the error be entered.

The Examiner notes that Shiohata, et al, U.S. Patent No. 4,245,950, teaches the construction of turbine blades wherein hook holding keys are used in the root section to attach the blades to a rotor (Column 2, lines 39-45).

The Examiner therefore notes that it would have been obvious to one skilled in the art at the time the invention was made to utilize the method of determining machining instructions shown by Rathi '572 to analyze specifically the root section of a turbine blade and also to utilize a hook holding key in the root of a turbine blade since the method shown by Rathi '572 can be used for machining any part having a contoured surface (Rathi '572, Column 1, lines 8-10) and since the use of hook holding keys is well known in the field of turbines (Shiohata, Column 3, lines 53-55).

Applicant respectfully traverses and requests reconsideration.

Applicant respectfully submits that, as indicated above, that the method shown by Rathi '572 is for machining a contoured surface (Column 1, lines 8-10) wherein the contoured surface is the outer surface of the object (emphasis added) (Column 1, lines 55-68). Applicant submits that the method shown by Rathi '572 requires the application of a sensing device wherein the outer surface is sensed by the device as a series of data points along the outer surface of the object (Column 3, lines 35-54).

Applicant respectfully submits that the Rathi '572 method requires as a first element the existence of an object having a contoured surface which can be the object whose outer surfaces can be sensed to determine the required milling instructions to mill the surface being sensed.

Applicant submits that without the existence of an object to serve as the sensing object, the method of Rathi '572 is inapplicable to devise machining instructions for an object for which only a sketch diagram is present and only on paper.

The instant invention overcomes the problem of not having a physical model present, as Rathi '572 requires, by working from a diagram constructed to define the required interior concave and convex surfaces of the resultant holding hooks of the root section of a turbine blade and the simultaneous movements of the spinning form cutter and the rotary table of the milling machine wherein the spinning form cutter travels in a convex path relative to the distance from the center of the rotary table and the first holding hook of the root section and the rotary table simultaneously rotates from a plus rotation angle to a minus rotation angle and alternatively, from a minus rotation angle to a plus rotation angle. The unique diagram accordingly permits an analysis by trigonometric methods by the operator to determine the required instructions to program a milling machine comprising at least a three-axis computer numerical control milling machine without the requirement of a physical model and algebraic analysis of algorithms to determine by computer programs the necessary instructions to program a milling machine to mill the outer surface of an existing physical object.

Applicant respectfully submits that the method of the instant invention is unobvious under 35 U.S.C. 103(a) over Rathi '572 considered separately and further in view of Shiohata '950 in that it is unexpected that a method for determining machining instructions of interior surfaces of an object existing only in the form of a diagram will provide the necessary machining instructions to machine the interior surfaces of a metal block to provide the precise concave and convex curved surfaces of the root section of a turbine bade, the said root section having at least a first hook as a first holding hook, wherein the diagram details the said curved surfaces and the simultaneous movements of the form cutter and the rotary table.

Rathi '572, separately, and in view of Shiohata '950 teaches a method of determining machining instructions from an existing object to finish machining the outer surface of the object with use of mechanical tools to devise measurements to perform the required machining of the object which measurements are substituted in algebraic equations and interpreted by computer programs to determine the necessary machining instructions. Shiohata '950 teaches the construction of turbine blades whereby hook holding keys are used in the root section to attach the blades to a rotor (Column 2, lines 39-45).

Rathi '572, separately, and in view of Shiohata '950 teaches a method of refurbishing a part already in existence whereas the instant invention teaches a method for machining a new part represented only by a diagram.

Applicant respectfully brings to the attention of the Examiner that the Applicant has amended the specification and claims to eliminate the reference to hook holding keys as being an improper, inaccurate use of the term "key" to teach and claim an element of the instant invention in an improper and inaccurate statement which the Applicant regrets submitting in error.

Applicant respectfully submits that Rathi '572, separately, and in view of Shiohata '950, teaches away from what is claimed. Applicant, by the method of the instant invention, is avoiding the necessity of having a model of a desired object to serve as a guide to determine machining instructions for a similar or like object.

Applicant respectfully submits that elimination of the need for a corresponding or like object from which to obtain measurements to program a milling machine is the very antithesis and direct opposite of obviousness.

Applicant respectfully submits that in view of the critical differences between the methods of the instant invention and the method taught by Rathi '572, separately, and in view of Shiohata '950, the method of Rathi '572 does not encompass the method of the instant invention. The cited reference, Rathi '572, separately, and in view of Shiohata '950, teaches and claims a different method, under different conditions of use, being directed to outer surface milling of objects, uses different procedures, and obtains a different product, i.e. not a product with internal concave and convex surfaces.

Applicant respectfully submits that it is unobvious and surprising, in view of the prior art cited, that a method of machining interior surfaces of a metal block to prepare the root section of a turbine blade having at least a first hook as a first holding hook, using a unique diagram of the required curved interior surfaces and the required movements of the moving elements of the computer numerical control milling machine, will provide the required milling machine product using the said unique diagram to determine the plurality of programmed instructions by an analysis by trigonometric methods of the said diagram.

Applicant therefore respectfully submits that Claims 1-4, as amended, are not anticipated under 35 U.S.C. 102(b) in view of Rathi, et al, U.S. Patent 5,285,572, and are unobvious under 35 U.S.C. 103(a) and Rathi, et al, U.S. Patent 5,285,572, separately, and in view of Shiohata, et al, U.S. Patent 4,245,950.

Respectfully submitted,

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APPENDIX A

Specification (Showing Changes)

Page 1, line 24:

Presently, the method of preparing these root sections of a turbine blade with the many successive machining operations requires separate tolerance measurements, separate machining operations and multiple set-ups. The instant invention has been devised with the view to substantially eliminating the many separate procedures inherent in the prior art of machining root sections of turbine blades and has as its essential object an improved method for machining the root section of [a] turbine blades on a vertical or horizontal machining center with rotary table.

Page 2, line 43;
Page 2, line 44; and
Page 3, line 1:

The root section of the turbine blade is designed to fit within precise tolerances upon a circular rotor. Because of the curvatures of the mating surface of the root section of the turbine blade and the mating section of the circular rotor, the machining of the root section of the turbine blade requires convex movements of the form cutter tool (9) and the rotating of the rotary table (7) which holds the root section of the turbine blades. The form cutter (9) travels on a convex line (center line, See Figure 5) from point A to point L following convex path [pad] (E+R), the form cutter spins and the rotary table [machine] simultaneously rotates from angle -Q° to angle +Q°, (See Figure 5) this operation can be also approached at point L and finished at point A.

Page 3, line 16:

The position of the rotary form cutter is moved closer to the root section as is required to cut the three identical cut surfaces which form holding hooks [keys]. Reference to Figure 5 explains the movement of the form cutter. As shown in Figure 5, radiuses R, R+D1, and R+D2 are radiuses on the part and are depicted by Figures 1, 2, 3, and 4.

Page 3, line 37:

R = Radius on first hook (dimension from Figure 5) holding hook [key];

Page 3, line 38:

E = Distance from center of rotary table to first hook holding hook [key];

Page 5, line 5:

Figures 2, 3, 4 and 5, describe one machining cutting pass for machining the curvature on the hooks as determined by [b] the controlling programming in use.

Page 5, line 38:

8. Roughing hook's [book's] shape and tang fits (milling)

Page 7, line 4:

The example of CAD was used as an example only. Rather, [it] the path of the tool which will always be the same regardless of what method is used to find the needed coordination points, angles and radius the sum of E + R. See Figure 5 and it is this that is the claimed invention.

APPENDIX B

Claims (Showing Changes)

1. (Once Amended) A method of determining machining instructions for milling machinery comprising at least a three-axis computer numerical control milling machine during machining of a work piece to machine precise concave and convex surfaces within a metal block, said method comprising, in combination, using a machine having a spinning form cutter and a rotary table, the surfaces of the work piece being defined by a plurality of programmed instructions for said computer numerical control milling machine obtained by trigonometric analysis of required curvatures of the surfaces and movements of said spinning form cutter and said rotary table, said movement of said spinning form cutter being in a convex path and said movement of said rotary table being to rotate simultaneously from a plus rotation angle to a minus rotation angle and, alternatively, from a minus rotation angle to a plus rotation angle, said programmed instructions determined by said trigonometric analysis of a diagram of required concave and convex surfaces of resulting root section of a turbine blade and movements of said spinning form cutter and rotary table, said root section having at least a first hook as a first holding hook.

2. (Once Amended) The method of Claim 1 wherein said trigonometric analysis of the required curvatures of the surfaces comprises analysis of a diagram of a graphical construction of the required curvatures of the surfaces and movements of said spinning cutter and said rotary table relative to the application of said spinning form cutter [the cutting tool] to the required curvatures of [the] said root section of [the] said turbine blade, said graphical construction consisting essentially of a trigonometric analysis, said root section comprising at least one holding hook [holding key].

3. (Once Amended) The method of Claim 1 wherein said trigonometric analysis of the required curvatures of the surfaces and movements of said spinning cutter and said rotary table determines the path of said spinning form cutter as a curved convex radius of E plus R wherein E is the distance [form] from center of rotary table to first holding hook and R is the radius on the first holding hook [holding key].

4. (Once Amended) The method of Claim 1 wherein said trigonometric analysis of the required curvatures of the surfaces and movements of said spinning cutter and said rotary table determines the path of said spinning form cutter as a curved convex radius of E plus R wherein E + R of the convex radius is determined by points L, C, and A, L being the minimum distance P and distance M determined by angle +Q°, the angle of rotation to the left, C being the minimum distance E determined by the angle 0°; A being the minimum distance F and distance Y determined by angle -Q°, the angle of rotation to the right; E being the distance from center of rotary table to first holding hook, and R the radius on the first holding hook.

A